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Declaration

I, Mariko Uchida, a translator of Fukuyama Sangyo Honyaku Center, Ltd., of 16-3, 2-chome, Nogami-cho, Fukuyama, Japan, do solemnly and sincerely declare that I understand well both the Japanese and English languages and that the attached document in English is a full and faithful translation, of the copy of Japanese Unexamined Patent No. Hei-7-288724 laid open on October 31, 1995.

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CAMERA ADAPTER

Japanese Unexamined Patent No. Hei-7-288724

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Applicant: Olympus Optical Co., Ltd.

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SPECIFICATION

[TITLE OF THE INVENTION] Camera Adapter

[ABSTRACT]

[Object] To provide an inexpensive camera adapter which enables electronic image recording without impairing the size of a lens shutter camera.

[Construction] An image-forming lens 34 forms, in an imaging element 36, a subject image of a range equivalent to a subject image formed on the film plane, an imaging element 36 receives light of the subject image formed by the image-forming lens 34 and outputs an image signal, and a memory 39 stores the image signal outputted from the imaging element 36. And, a frame body comprises the image-forming lens 34, the imaging element

36, and the memory 39, and is freely attachable and detachable with respect to the camera body. Furthermore, the memory 39 is also freely attachable and detachable with respect to the camera body.

[WHAT IS CLAIMED IS;]

[Claim 1] A camera adapter which is freely attachable and detachable with respect to a camera body, comprising:

a demagnification optical system for forming a subject image of a range equivalent to that of a subject image formed on a film plane;

an imaging element for receiving light of a subject image formed by the demagnification optical system and outputting an image signal;

a storing means for storing the image signal outputted from the imaging element; and

a frame body comprising the demagnification optical system, the imaging element, and the storing means, freely attachable and detachable with respect to the camera body, wherein

the subject image can be electrically stored.

[Claim 2] A camera adapter which is freely attachable and detachable with respect to a camera body, comprising:

a demagnification optical system for forming a subject image

of a range equivalent to that of a subject image formed on a film plane, arranged at a position to receive a subject light flux from a taking lens;

an imaging element for receiving light of a subject image formed by the demagnification optical system and outputting an image signal;

a storing means for storing the image signal outputted from the imaging element;

a frame body comprising the demagnification optical system, the imaging element, and the storing means and is freely attachable and detachable with respect to the camera body; and

a communications means for communicating with a control means within the camera body, provided in the frame body, wherein

the subject image can be electrically stored by attaching the frame body to the camera body.

[Claim 3] A camera adapter which is freely attachable and detachable with respect to a camera body, comprising:

a demagnification optical system for forming a subject image of a range equivalent to that of a subject image formed on a film plane, arranged at a position to receive a subject light flux from a taking lens;

an imaging element for receiving light of a subject image

formed by the demagnification optical system and outputting an image signal;

a storing means for storing the image signal outputted from the imaging element;

a communications means for communicating with a control means of the camera body;

an evacuating means for evacuating at least one of the demagnification optical system and imaging element when a photographic optical system of the camera body is collapsed or is retracted to shorten the focal length; and

a frame body in which the imaging element, the demagnification optical system, the storing means, the communications means, and the evacuating means are arranged, wherein

the subject image can be electrically stored by attaching the frame body to the camera body.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention] The present invention relates to a camera adapter which makes, in an imaging device such as a camera, photography using a silver salt film and electronic image recording freely switchable.

[0002]

[Prior Arts] Priorly, techniques related to electronic still cameras which convert photographic images to electric signals by means of photoelectric transducers and store the same on various recording media have been disclosed. Moreover, techniques by which the rear cover of a camera using a silver salt film is removed, a unit having an electronic imaging element is attached in place to use the camera as an electronic still camera have also been proposed.

[0003] As an example thereof, in Japanese Unexamined Patent Publication No. Hei-2-276375, a technique related to "a camera capable of selecting two recording methods" has been disclosed, which selects a photographic recording method according to the date and time of photography by selecting either a first body portion including an imaging element, an electric circuit system, and a magnetic recording device and a second body portion which can incorporate a silver salt film and making the same freely attachable and detachable.

[0004] Furthermore, in Japanese Unexamined Patent Publication No. Hei-4-373367, a technique related to "an electronic imaging back" has been disclosed, which can carry out electronic photography in a manner attached to a camera body, without the necessity of a correcting photographic optical system or a correcting finder optical system for electronic images, by

providing the photoelectric transducer-imaging element with an imaging plane of a size approximately equal to an aperture size of the camera body using a silver salt film.

[0005]

[Problems to be Solved by the Invention] However, in the technique disclosed by the above-described Japanese Unexamined Patent Publication No. Hei-2-276375, since replacement in body units is necessary between the silver film and electronic images, the costs become expensive. Furthermore, in the above-described Japanese Unexamined Patent Publication No. Hei-4-373367, since it is necessary to equalize the imaging element to the aperture size of the silver salt film, the costs become very expensive.

[0006] The present invention has been made in view of the above-described problems, and an object thereof is to provide an inexpensive camera adapter which enables electronic image recording without impairing the size of a lens shutter camera.

[0007]

[Means for solving the Problems] In order to achieve the above-described object, a camera adapter according to a first embodiment of the present invention comprises; in a camera adapter which is freely attachable and detachable with respect to a camera body, a demagnification optical system for forming

a subject image of a range equivalent to that of a subject image formed on a film plane; an imaging element for receiving light of a subject image formed by the demagnification optical system and outputting an image signal; a storing means for storing the image signal outputted from the imaging element; and a frame body comprising the demagnification optical system, the imaging element, and the storing means, freely attachable and detachable with respect to the camera body, wherein the subject image can be electrically stored.

[0008] And, a camera adapter according to a second embodiment of the present invention comprises: in a camera adapter which is freely attachable and detachable with respect to a camera body, a demagnification optical system for forming a subject image of a range equivalent to that of a subject image formed on a film plane, arranged at a position to receive a subject light flux from a taking lens; an imaging element for receiving light of a subject image formed by the demagnification optical system and outputting an image signal; a storing means for storing the image signal outputted from the imaging element; a frame body comprising the demagnification optical system, the imaging element, and the storing means and is freely attachable and detachable with respect to the camera body; and a communications means for communicating with a control means

within the camera body, provided in the frame body, wherein the subject image can be electrically stored by attaching the frame body to the camera body.

[0009] A camera adapter according to a third embodiment of the present invention comprises: in a camera adapter which is freely attachable and detachable with respect to a camera body, a demagnification optical system for forming a subject image of a range equivalent to that of a subject image formed on a film plane, arranged at a position to receive a subject light flux from a taking lens; an imaging element for receiving light of a subject image formed by the demagnification optical system and outputting an image signal; a storing means for storing the image signal outputted from the imaging element; a communications means for communicating with a control means of the camera body; an evacuating means for evacuating at least one of the demagnification optical system and imaging element when a photographic optical system of the camera body is collapsed or is retracted to shorten the focal length; and a frame body in which the imaging element, the demagnification optical system, the storing means, the communications means, and the evacuating means are arranged, wherein the subject image can be electrically stored by attaching the frame body to the camera body.

[0010]

[Actions] Namely, in the camera adapter according to the first embodiment of the present invention, the demagnification optical system forms a subject image of a range equivalent to a subject image formed on the film plane, the imaging element receives light of a subject image formed by the demagnification optical system and outputs an image signal, and the storing means stores the image signal outputted from the imaging element. The frame body comprises the demagnification optical system, the imaging element, and the storing means, and is freely attachable and detachable with respect to the camera body.

[0011] In the camera adapter according to the second embodiment, the demagnification optical system forms a subject image of a range equivalent to a subject image formed on the film plane, the imaging element receives light of a subject image formed by the demagnification optical system and outputs an image signal, and the storing means stores the image signal outputted from the imaging element. The frame body comprises the demagnification optical system, the imaging element, and the storing means, and is freely attachable and detachable with respect to the camera body. Furthermore, the communications means is provided in the frame body, and communicates with a

control means within the camera body.

[0012] Furthermore, in the camera adapter according to the third embodiment, the demagnification optical system is arranged at a position to receive a subject light flux from a taking lens and forms a subject image of a range equivalent to that of a subject image formed on a film plane, the imaging element receives light of a subject image formed by the demagnification optical system and outputs an image signal, the storing means stores the image signal outputted from the imaging element. And, the communications means communicates with a control means of the camera body, and the evacuating means evacuates at least one of the demagnification optical system and imaging element when a photographic optical system of the camera body is collapsed or is retracted to shorten the focal length. In the frame body, the demagnification optical system, the imaging element, and the storing means are arranged.

[0013]

[Embodiments] Hereinafter, embodiments of the present invention will be described with reference to the drawings. First, in Fig. 2, a construction of a camera to which a camera adapter of the present invention is to be attached is shown for description. As shown in the same drawing, positive and

negative, two groups of zoom lenses 1 and 2, a lens shutter 3, an aperture 4, and a film 5 are arranged on an optical path of a subject light. To this zoom lens 1, a lens encoder 24 is connected, and an output of this lens encoder 24 is connected to an input of the lens drive circuit 23.

[0014] Furthermore, a shutter control circuit 25 is connected to the lens shutter 3, and a zoom encoder 27 is connected to the zoom lens 2. An output of this zoom encoder 27 is connected to an input of a zoom drive circuit 26, and this zoom drive circuit 26 is connected to the zoom lenses 1 and 2.

[0015] Furthermore, in an observation optical system, an object lens 6 of a real-image-type zoom finder, prisms 7 and 8 for an up-and-down and right and left inversion, and an ocular lens 9 are respectively arranged, and via these a subject light is led to a photographer's eye.

[0016] In addition, to an auto-focusing (AF) circuit 14, an infrared emitting diode (IRED; Infra Red Emitting Diode) 12 and a position detecting element (PSD) 13 are connected, and on an optical path of a light projected from the IRED 12, a light-projection lens 10 is arranged, and on an optical path of a reflected light of the light from a subject and at a position facing the PSD 13, a light-receiving lens 11 is arranged. An output of the AF circuit 14 is connected to inputs

of a protruding amount computing circuit 15 and a Flashmatic (FM; Flash Matic) computing circuit 20.

[0017] And, on the optical path of the subject light, a photo-detection element (SPD; Silicon Photo Diode) 17 is also arranged via an autoexposure (AE) lens, and an output of this SPD 17 is connected to an input of a control circuit 33 via an AE computing circuit 18.

[0018] Furthermore, to the input of this control circuit 33, outputs of a release input circuit 28 and a zoom input circuit 29 as well as the protruding amount computing circuit 15 are connected, and an output of this control circuit 33 is connected to inputs of a display circuit 30, a light-emission control circuit 21, a lens drive circuit 23, a shutter control circuit 25, a zoom drive circuit 26, a magnetic recording circuit 31, and a film feeding circuit 32, respectively.

[0019] In addition, an output of a DX code reading circuit 19 is connected to inputs of the AE circuit 14 and FM computing circuit 20, and an output of this FM computing circuit 20 is connected to an input of a strobe emitting circuit 2 via the light-emission control circuit 21.

[0020] In such a construction, a subject image is formed on the film 3 via the zoom lenses 1 and 2, lens shutter 3, and aperture 4. At this time, the aperture 4 restricts an image

plane size of the film 3. And, the subject image light is, in the observation optical system, led via the object lens 6, prisms 7 and 8 for an up-and-down and right and left inversion, and ocular lens 9 to a photographer's eye, as well.

[0021] And, an infrared light made incident from the IRED 12 is projected onto a subject via the projection lens 10, and a reflected light at this subject is received via the light-receiving lens 11 by the PSD 13. The AF circuit 14 outputs, based on an output of this PSD 13, by use of the principle of triangulation, a reciprocal number 1/l of a subject distance l to the protruding amount computing circuit 15 and FM computing circuit 20. In the protruding amount computing circuit 15, a lens protruding amount is computed based on this reciprocal number of the subject distance 1/l and a focal length of the taking lens.

[0022] Furthermore, the subject light is also received by a SPD 17 via an AE lens 16, and this SPD 17 outputs a photocurrent proportional to brightness of the subject to the AE computing circuit 18. This AE computing circuit 18 determines, from an output signal from the DX code reading circuit 19 and an output signal from the SPD 17, a shutter speed on the basis of the following expression (1). Here, AV denotes an aperture, TV denotes a shutter speed, BV denotes a subject brightness, and

SVF denotes a film sensitivity.

[0023]

$$EV = AV + TV = BV + SVF \quad \cdots (1)$$

And, the FM computing circuit 20 calculates, based on distance data, a strobe light-emission amount which becomes appropriate when the strobe is used on the basis of the following expression (2). Here, GV denotes a strobe light amount, DV denotes a subject distance, and AV0 denotes an open aperture.

[0024]

$$GV + SVF = AV0 + DV \quad \cdots (2)$$

In addition, the light-emission control circuit 21 controls the light-emission amount based on the strobe light amount value GV calculated in the FM computing circuit 20, the lens drive circuit 23 drives the lens for focusing, and the lens encoder 24 detects a lens position.

[0025] And, the zoom drive circuit 26 controls by driving the focal length of the taking lens, and the zoom encoder 27 outputs the focal length as required. Furthermore, the release input circuit 28 outputs, when an unillustrated release button is pressed halfway, a first release signal and outputs, when the same is completely pressed, a second release signal to the control circuit 37.

[0026] Furthermore, the magnetic recording circuit 31 is for

recording magnetic data on a magnetic recording layer provided outside the image plane of the film 5, and the film feeding circuit 32 carries out feeding such as winding and rewinding of the film 3.

[0027] In a case where a camera adapter of the present invention has been attached to a camera constructed as in the above, an overall construction thereof is as shown in Fig. 1. Namely, with an adapter portion 35 to be fitted in the camera aperture 4, an image-forming lens 34 and an imaging element 36 are integrally constructed. The image-forming lens 34 and imaging element 36 are arranged so that the adapter portion 35 is, when being fitted in the aperture 4, positioned on an optical path of a subject light. And, an output of this imaging element 36 is connected to an input of a memory 39 via a preamplifier 43, a signal processing circuit 44, an A/D conversion circuit 45, an image compressing circuit 46, and a memory drive circuit 47.

[0028] Furthermore, a sequence circuit 37 is mutually connected to the camera-side control circuit 33, and is also mutually connected to a lens protruding amount correcting circuit 38 and an electronic shutter speed computing circuit 40. And, an output of the sequence circuit 37 is connected to inputs of the memory drive circuit 47, the signal processing circuit

44, an electronic shutter timing circuit 42, and an imaging element drive circuit 41. In addition, outputs of the electronic shutter timing circuit 42 and imaging element drive circuit 41 are connected to an input of the imaging element 36.

[0029] In such a construction, the above-described lens protruding amount correcting circuit 38 is changed in the protruding amount of the lens 1 by insertion of the focusing lens 34 even with an identical subject distance, therefore the lens protruding amount correcting circuit 38 calculates that amount and outputs the same to the sequence circuit 37.

[0030] And, the electronic shutter speed computing circuit 40 is changed in the full-aperture f-number of the whole by insertion of the focusing lens 34 and therefore calculates, in consideration of a sensitivity SVC of the imaging element 36, on the basis of the following expression (3), an electronic shutter speed TVC at which the imaging element 36 becomes appropriate and outputs the same to the control circuit 37.

[0031]

$$AVC0 + TVC = BV + SVC \quad \cdots (3)$$

Furthermore, the sequence circuit 37 takes charge of control of the overall camera adapter, and carries out data communications with the camera-side control circuit 33. And,

the imaging element drive circuit 41 outputs a synchronous clock of the imaging element 36, and the electronic shutter timing circuit 42 controls electronic shutter timing.

[0032] When a subject image is formed in the imaging element 36 via the focusing lens 34, signals of this imaging element 36 are amplified in the preamplifier 43 and then receive predetermined image signal processing in the signal processing circuit 44, and are converted to digital signals in the A/D conversion circuit 45.

[0033] And, these digital signals are compressed in the image compressing circuit 46 and are then stored in the memory 39 via the memory drive circuit 47. Here, this memory 39 is freely attachable and detachable with respect to a camera adapter.

[0034] Herein, as shown in Fig. 3, ordinarily, even a lens with a focal length f1 is changed in focal length by insertion of a camera adapter. Now, where a focal length of the focusing lens 34 is provided as f2 and a principal point distance between the zoom lens 1 and focusing lens 34 is provided as Δ, a composed focal length f′ is generally expressed by the following expression.

[0035]

[Numerical expression 1]

$$\frac{1}{f'} = \frac{1}{f1} + \frac{1}{f2} - \frac{\Delta}{f1\ f2} \quad \cdots (4)$$

[0036] In this Fig. 3, since the focal length becomes approximately 1/2, the size of the imaging element 36 also becomes 1/2. Here, if there were no image-forming lens 34, the imaging element 36 would require a size equal to the aperture to obtain a similar angle of view, and the costs would become expensive. However, the present invention has solved this problem as described above.

[0037] Moreover, a mechanical layout of a camera adapter of the present invention is as shown in Fig. 4. As shown in the same drawing, the adapter portion 35 is connected to an interchangeable rear cover 65 by a spring 64. And, with respect to a camera, this is connected by a camera connector 66 to enable data communications. As this camera-side terminal, a terminal which has been conventionally provided for carrying out various adjustments during factory shipment is used. Furthermore, symbols 68 denote various integrated circuits, wherein the sequence circuit 37 is also included. And, a memory card 48 is inserted through an insertion slot in the rear of the rear cover, and this is connected to a memory connector 67 when being inserted.

[0038] Hereinafter, referring to a flowchart of Fig. 5, operations of the above-described camera will be described. With an operation of an unillustrated power switch, when

electric power is supplied to the control circuit 33 (step S1), the control circuit 33 carries out a predetermined display on the display circuit 30 (step S2). And, if there is a zoom input given by the zoom input circuit 29 (step S3), the control circuit 33 carries out zoom control by actuating the zoom drive circuit 26 (step 4). And, when a first release signal is outputted from the release input circuit 28 (step S5) by an unillustrated release button pressed approximately halfway, the control circuit 33 carries out auto-focusing by the AF circuit 14 and calculates a reciprocal number 1/l of a subject distance l by use of the principal of triangulation (steps S6 and S7).

[0039] Subsequently, the protruding amount computing circuit 15 reads out a signal of the zoom encoder 27 and computes a lens protruding amount based on this signal and the above-described 1/l (steps S8 and S9). Then, photometry is carried out, a DX code of a film cartridge is read out by the DX code reading circuit 19, and based on these, AE computing by the AE computing circuit 18 is carried out to calculate a photometric value (steps S8-S12).

[0040] Then, if strobing is necessary (step S13), FM computing by the FM computing circuit is carried out, and after a strobe light-emission amount 20 is determined, a shutter speed is

determined based on the photometric value (steps S15-S17). In contrast thereto, if strobing is unnecessary, a shutter speed is promptly determined (step S14).

[0041] Thus, when the unillustrated release button is completely pressed and a second release signal is outputted to the control circuit 33 from the release input circuit 28 (step S18), the lens drive circuit 23 makes the lens 1 protrude based on the protruding amount determined in advance, and the lens shutter 3 is opened to expose the film 5 until a timer counts up, namely, for a predetermined time. At this time, in a case where the strobe is used, after strobe emitting by a strobe emitting circuit 22, the lens shutter 3 is closed (steps S19-S25). Subsequently, the lens is reset, and after the film 5 is wound by one frame by the film feeding circuit 32, magnetic recording is carried out on a magnetic recording layer of an image plane of this film, and all operations are ended (steps S26-S28).

[0042] Next, referring to a flowchart of Fig. 6, operations in a case where a camera adapter has been attached to the above-described camera will be described. With an operation of the unillustrated power switch, when electric power is supplied to the control circuit 33 and sequence circuit 37 (step S101), the camera adapter-side sequence circuit 37 carries out

data communications with the camera-side control circuit 3, and the camera-side control circuit 33 recognizes an attachment of the camera adapter (step S102).

[0043] The camera-side control circuit 33 transmits, to the camera adapter-side sequence circuit 37, focal length data, full-aperture f-number data, other correcting data, and zoom inhibiting region data. This zoom inhibiting data is data to be used if an unusable zoom region occurs as a result of an attachment of the image-forming lens 34 (steps S103-S107). Subsequently, if there is a zoom input given by the zoom input circuit 29, zoom control is carried out only when it is not in the above-described zoom inhibiting region, and if it is in the above-described zoom inhibiting region, zooming is stopped and warning is given to the display circuit 30. And, if there is no zoom input, zooming is stopped (steps S108-S114).

[0044] And, when the unillustrated release button is pressed approximately halfway and a first release signal is outputted from the release input circuit 28 to the control circuit 33 (step S110), an AF operation by the AF circuit 14 is carried out (step S115), a reciprocal number 1/1 of a subject distance 1 is calculated (step S116), a signal of the zoom encoder 27 is read out (step S117), a focal length f1 is calculated (step

S118), photometry is carried out to calculate a subject brightness BV (step S119), and the control circuit 33 transmits the 1/l, focal length f1, and subject brightness BV to the sequence circuit 37 of the adapter (step S120).

[0045] Subsequently, at the camera adapter side, the lens protruding amount correcting circuit 38 calculates a lens protruding amount based on the above-described 1/l and focal length f1 (step S121). Herein, description will be given of this computing with reference to Fig. 7. Generally, when a lens with a focal length f1 is focused on a subject positioned at a distance l by protruding the whole, a lens protruding amount K from an infinity position is expressed by the following expression (5).

[0046]

[Numerical expression 2]

$$K = \frac{f1^2}{l} \quad \cdots (5)$$

In addition, if, in terms of zoom lenses, a longitudinal magnification of the first group with respect to a film plane is β^2, a lens protruding amount K is expressed by the following expression (6).

[0047]

[Numerical expression 3]

$$K = \frac{f1^2}{1} \times \frac{1}{\beta^2} \qquad \cdots (6)$$

And, with the image-forming lens 34 inserted, the above-described expression (6) becomes the following expression (7).

[0048]

[Numerical expression 4]

$$K = \frac{f1^{-2}}{1} \times \frac{1}{\beta^{-2}} \qquad \cdots (7)$$

[0049] Herein, f' denotes a composite focal length of the above-described expression (4), and β^2 denotes a longitudinal magnification after composition. As such, the lens protruding amount is corrected. Subsequently, necessity of strobing is judged based on the subject brightness BV, and if strobing is necessary, an FM correcting operation is executed by the FM computing circuit 20, a strobe light-emission amount is determined by the strobe emitting circuit 22, an electronic shutter speed is determined, and a mechanical shutter speed is determined. On the other hand, if strobing is unnecessary, an electronic shutter speed is determined, and a mechanical shutter speed is determined. The above-described electronic shutter speed is obtained by the above-described expression (3), and it is necessary to set the above-described mechanical shutter speed slightly longer than the electronic shutter speed. The lens protruding amount, mechanical shutter speed, and

strobe light-emission amount are transmitted to the camera side (steps S122-S129).

[0050] Thus, when the unillustrated release button is completely pressed and a second release signal is outputted from the release input circuit 28 to the control circuit 33, lens protrusion is carried out, and the mechanical shutter is opened. When the data is transmitted to the camera adapter, the electronic shutter is opened, and the electronic shutter is closed after a predetermined time. At this time, if strobing is necessary, the strobe is emitted (steps S130-S140).

[0051] Furthermore, after an elapse of a predetermined time (step S141), the mechanical shutter is closed, the lens is reset, and all operations are ended (steps S142 and S143). In the above, a description has been given of constructions and operations of a camera and a camera adapter. Now, description will be given of a monitor device for confirming image data stored in the memory 39 in a condition where a camera adapter has actually been attached with reference to Fig. 8.

[0052] As shown in this Fig. 8, when the memory 39 is connected to a monitor device, digital signals thereof are read out by a memory drive circuit 49. And, the compressed digital signals are restored (expanded) by an image restoring circuit 50, are converted to analog signals in a D/A conversion circuit 51,

and are outputted to a monitor 53 via a monitor drive circuit 52, and thus an image is displayed on the monitor 53. At this time, a frame number, etc., is instructed by an input circuit 54, and operation of the whole is controlled by a control portion 55.

[0053] Lastly, description will be given of a modification of the aforementioned camera adapter with reference to Fig. 9. A camera adapter according to this modification has been made while considering a breakage prevention when a lens is retracted to collapse a camera.

[0054] Namely, a positioning portion 62 fitted in the aperture 4 and a shift frame 63 are fitted in the optical axis direction. An image-forming lens 34 and an imaging element 36 are disposed therein. A spring 64 is provided between the shift frame 63 and rear cover 65 and couples these to each other.

[0055] Therefore, when the taking lens is collapsed from a condition shown in Fig. 9(b) to a condition shown in Fig. 9(a), the shift frame 63 is pushed by a frame 61 of a zoom lens 2 of the two groups and is retracted; breakage of either can be prevented from occurring.

[0056] As has been described in detail, according to a camera adapter of the present invention, an inexpensive camera adapter can be provided without impairing the size of a lens shutter

camera. Here, according to the above-described embodiments of the present invention, constructions as in the following can be obtained.

(1) A camera adapter which has: an imaging element for forming a subject image; a demagnification optical system for making the imaging element form an image of a region almost equivalent to a region which a photographic optical system of a silver salt film camera can photograph; a storing means for storing an output of the imaging element; a communications means for data communications with the silver salt film camera; and a frame body in which the imaging element, the demagnification optical system, the storing means, and the communications means are arranged, and which is capable of electrically recording a subject image by attaching the frame body to the silver salt film camera.

(2) A camera adapter which has: an imaging element for forming a subject image; a demagnification optical system which is, for making the imaging element form an image of a region almost equivalent to a region which a photographic optical system of a silver salt film camera can photograph, inserted behind the photographic optical system; a storing means for storing an output of the imaging element; a communications means for data communications with a CPU of the silver salt film camera; and

a frame body in which the imaging element, the demagnification optical system, the storing means, and the communications means are arranged and which is constructed so as to insert the demagnification optical system through an aperture of the silver salt film camera, and which is capable of electrically recording a subject image by attaching the frame body to the silver salt film camera.

(3) A camera adapter which has: an imaging element for forming a subject image; a demagnification optical system which is, for making the imaging element form an image of a region almost equivalent to a region which a photographic optical system of a silver salt film camera can photograph, inserted behind the photographic optical system; a storing means for storing an output of the imaging element; a communications means which is for data communications with a CPU of the silver salt film camera and whose communications contents are related to a focus adjustment and an exposure adjustment resulting from insertion of the demagnification optical system; and a frame body in which the imaging element, the demagnification optical system, the storing means, and the communications means are arranged and which is constructed so as to insert the demagnification optical system through an aperture of the silver salt film camera, and which is capable of electrically recording a

subject image by attaching the frame body to the silver salt film camera.

(4) A camera adapter which has: an imaging element for forming a subject image; a demagnification optical system which is, for making the imaging element form an image of a region almost equivalent to a region which a photographic optical system of a silver salt film camera can photograph, inserted behind the photographic optical system; a storing means for storing an output of the imaging element; a communications means which is for data communications with a CPU of the silver salt film camera and whose communications contents are related to a change in the lens protruding amount resulting from insertion of the demagnification optical system; and a frame body in which the imaging element, the demagnification optical system, the storing means, and the communications means are arranged and which is constructed so as to insert the demagnification optical system through an aperture of the silver salt film camera, and which is capable of electrically recording a subject image by attaching the frame body to the silver salt film camera.

(5) A camera adapter which has: an imaging element for forming a subject image; a demagnification optical system which is, for making the imaging element form an image of a region almost

equivalent to a region which a photographic optical system of a silver salt film camera can photograph, inserted behind the photographic optical system; a storing means for storing an output of the imaging element; a communications means which carries out data communications with a CPU of the silver salt film camera by use of an input/output terminal used for adjustments during factory shipment of the silver salt film camera; and a frame body in which the imaging element, the demagnification optical system, the storing means, and the communications means are arranged and which is constructed so as to insert the demagnification optical system through an aperture of the silver salt film camera, and which is capable of electrically recording a subject image by attaching the frame body to the silver salt film camera.

(6) A camera adapter which has: an imaging element for forming a subject image; a demagnification optical system which is, for making the imaging element form an image of a region almost equivalent to a region which a photographic optical system of a silver salt film camera can photograph, inserted behind the photographic optical system; a storing means for storing an output of the imaging element; a communications means for data communications with a CPU of the silver salt film camera; an evacuating means for evacuating at least one of the

demagnification optical system and imaging element when the photographic optical system of the silver salt film camera is collapsed or is retracted to shorten the focal length; and a frame body in which the imaging element, the demagnification optical system, the storing means, the communications means, and the comparison means are arranged and which is constructed so as to insert the demagnification optical system through an aperture of the silver salt film camera, and which is capable of electrically recording a subject image by attaching the frame body to the silver salt film camera.

[0057]

[Effects of the Invention] According to the present invention, a camera adapter which enables electronic image recording without impairing the size of a lens shutter camera can be provided.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1] A view showing an overall construction in a case where a camera adapter of the present invention has been attached.

[Fig. 2] A view showing a camera to which a camera adapter of the present invention is to be attached.

[Fig. 3] Views showing a condition where focal length is changed by an attachment of a camera adapter.

[Fig. 4] A view showing a mechanical layout of a camera adapter

of the present invention.

[Fig. 5] A flowchart showing operations in a case where no camera adapter has been attached to a camera.

[Fig. 6] A flowchart showing operations in a case where a camera adapter has been attached to a camera.

[Fig. 7] Diagrams for explaining computing of a lens protruding amount based on 1/l and focal length f1 by the lens protruding amount correcting circuit 30.

[Fig. 8] A view showing a construction of a monitor device to confirm image data stored in a memory 39 in a condition where a camera adapter has been actually attached.

[Fig. 9] Views showing a construction of an improved example of a camera adapter.

[Description of Symbols]

1, 2 … zoom lens, 3 … lens shutter, 4 … aperture, 5 … film, 6 … object lens, 7, 8 … prism, 9 … ocular lens, 10 … light-projection lens, 11 … light-receiving lens, 12 … IRED, 13 … PSD, 14 … AF circuit, 15 … protruding amount computing circuit, 16 … AE lens, 17 … SPD, 18 … AE computing circuit, 19 … DX code reading circuit, 20 … FM computing circuit, 21 … light-emission control circuit, 22 … strobe emitting circuit, 23 … lens drive circuit, 24 … lens encoder, 25 … shutter control circuit, 26 … zoom drive circuit, 27 … zoom encoder, 28 … release

input circuit, 29 … zoom input circuit, 30 … display circuit, 31 … magnetic recording circuit, 32 … film feeding circuit, 33 … control circuit.

[Fig. 1]

14 AF circuit

15 Protruding amount computing circuit

18 AE computing circuit

20 FM computing circuit

22 Strobe emitting circuit

21 Light-emission control circuit

24 Lens encoder

23 Lens drive circuit

25 Shutter control circuit

26 Zoom drive circuit

27 Zoom encoder

19 DX code reading circuit

30 Display circuit

28 Release input circuit

29 Zoom input circuit

33 Control circuit

31 Magnetic recording circuit

32 Film feeding circuit

37 Sequence circuit

38 Lens protruding amount correcting circuit

40 Electronic shutter speed computing circuit

43 Preamplifier

44 Signal processing circuit

45 A/D conversion circuit

46 Image compressing circuit

47 Memory drive circuit

39 Memory

42 Electronic shutter timing circuit

41 Imaging element drive circuit

[Fig. 2]

14 AF circuit

15 Protruding amount computing circuit

18 AE computing circuit

20 FM computing circuit

22 Strobe emitting circuit

21 Light-emission control circuit

24 Lens encoder

23 Lens drive circuit

25 Shutter control circuit

26 Zoom drive circuit

27 Zoom encoder

19 DX code reading circuit

30 Display circuit

28 Release input circuit

29 Zoom input circuit

33 Control circuit

31 Magnetic recording circuit

32 Film feeding circuit

[Fig. 7] (a) (b)

Protruding amount

(Subject distance)

[Fig. 5]

S1 Power ON

S2 Display ON

S3 Zoom input exists.

S4 Zoom control

S5 1R ON

S6 AF operation

S7 1/l calculation

S8 Zoom encoder read-out

S9 Lens protruding amount computing

S10 Photometry

S11 DX code read-out

S12 AE computing

S13 Strobe is necessary.

S14 Shutter speed determination

S15 FM computing

S16 Strobe light-emission amount determination

S17 Shutter speed determination

S18 2R ON

S19 Lens protrusion

S20 Shutter opening

S21 Timer set start

S22 Timer count-up

S23 Strobe exists.

S24 Strobe light-emission control

S25 Shutter opening

S26 Lens reset

S27 Film feeding

S28 Magnetic recording

[Fig. 6]

S101 Power ON

S102 Adapter exists.

Conventional camera

S103 Display ON

S104 Focal length data transmission

S105 Full-aperture FN transmission

S106 Other correcting data transmission

S107 Zoom inhibiting data transmission

S108 Zoom input exists.

S109 Zoom stop

S110 1R ON

S111 Zoom inhibiting region

S112 Zoom control

S113 Zoom stop

S114 Warning

S115 AF operation

S116 1/l calculation

S117 Zoom encoder read-out

S118 Focal length calculation

S119 Photometry

S120 Transmission of 1/l data, focal length, and photometric value

S121 Lens protruding amount correcting operation

S122 Strobe is necessary.

S123 Electronic shutter speed determination

S124 Mechanical shutter speed determination

S125 Transmission of lens protruding amount, mechanical shutter speed, strobe light-emission amount

S126 FM correcting operation

S127 Strobe light-emission amount determination

S128 Electronic shutter speed determination

S129 Mechanical shutter speed determination

S130 2R ON

S131 Lens protrusion

S132 Mechanical shutter opening

S133 Timer 2 set start

S134 Mechanical shutter opening

Signal transmission

S135 Electronic shutter opening

S136 Timer 1 set start

S137 Timer 1 count-up

S138 Strobe exists.

S139 Strobe radiation

S140 Electronic shutter closing

S141 Timer 2 count-up

S142 Mechanical shutter closing

S143 Lens reset

[Fig. 8]

48 Memory

49 Memory drive circuit

50 Image restoring circuit

51 D/A conversion circuit

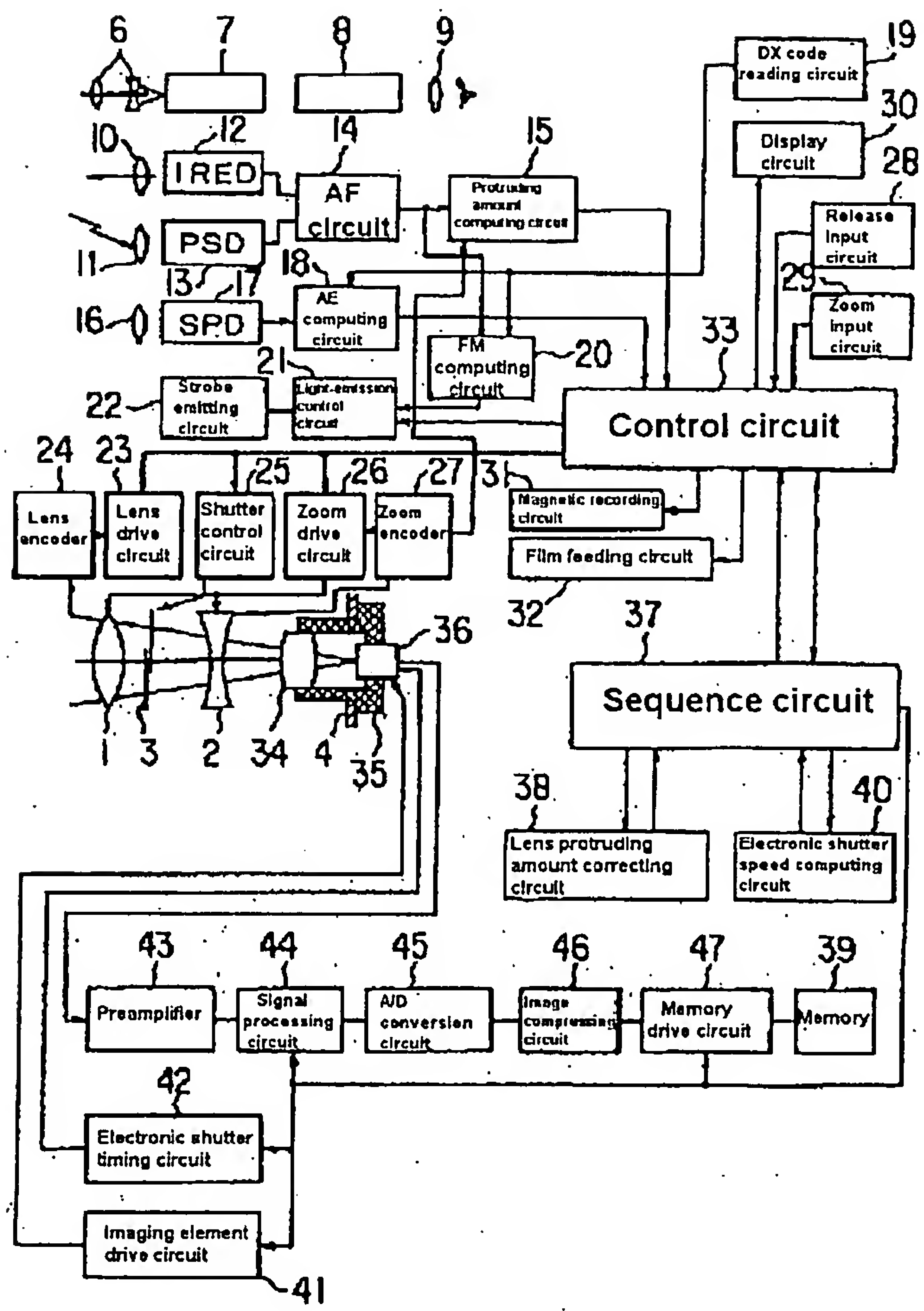
52 Monitor drive circuit

53 Monitor

55 Control portion

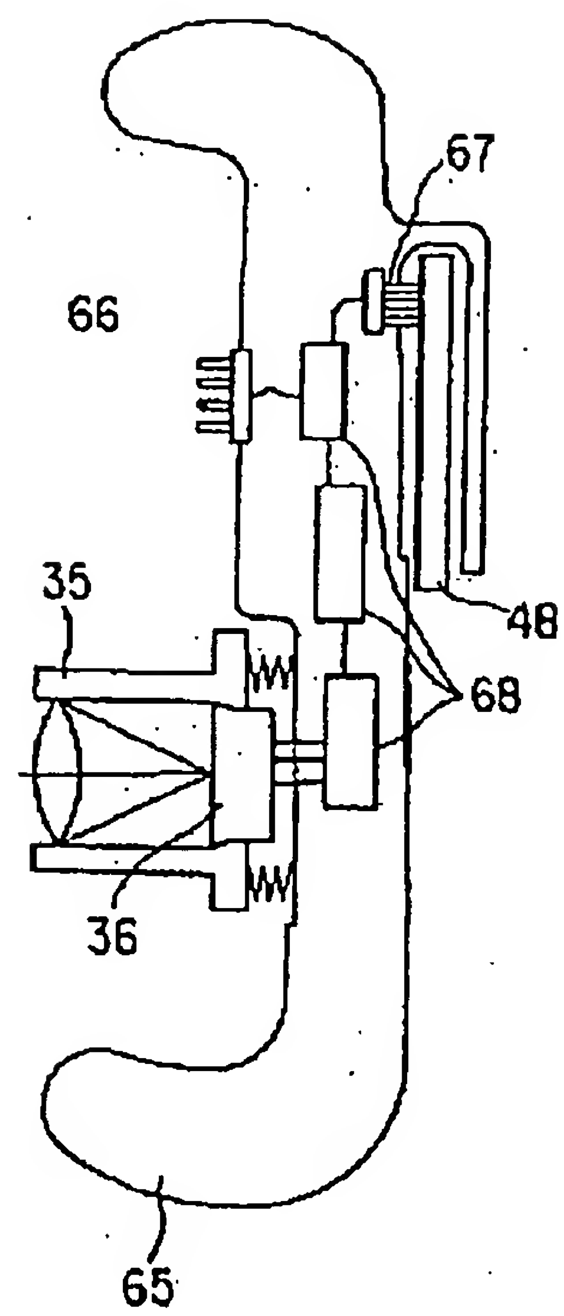
54 Input circuit

Fig. 1



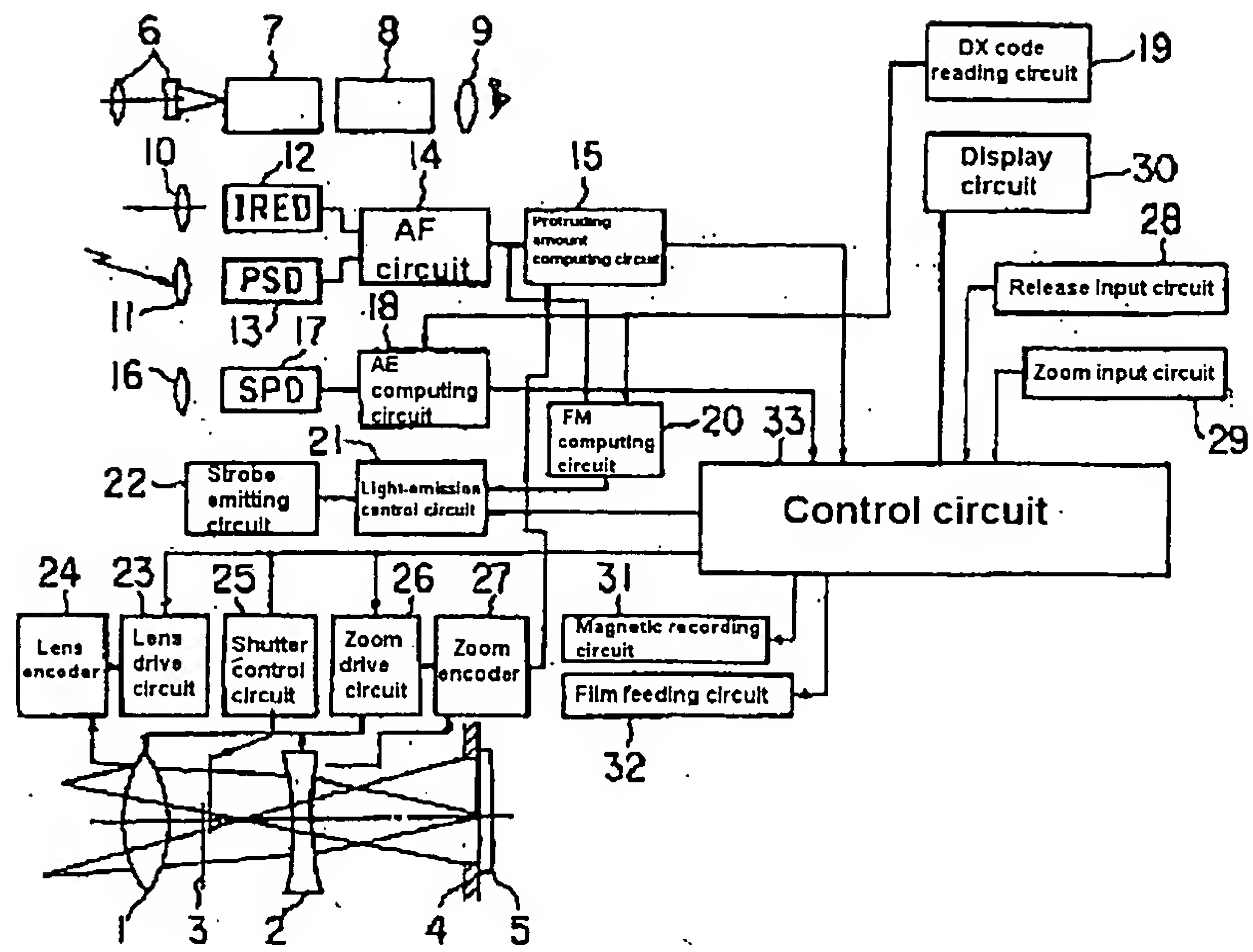
6
7
8
9
10
12
IRED
14
AF circuit
15
Protruding amount computing circuit
PSD
11
13
17
18
AE computing circuit
16
SPD
FM computing circuit
20
21
22
Strobe emitting circuit
Light-emission control circuit
19
DX code reading circuit
30
Display circuit
28
Release input circuit
29
Zoom input circuit
33
Control circuit
24
23
25
26
27
31
Lens encoder
Lens drive circuit
Shutter control circuit
Zoom drive circuit
Zoom encoder
Magnetic recording circuit
Film feeding circuit
32
37
36
1
3
2
34
4
35
Sequence circuit
38
Lens protruding amount correcting circuit
40
Electronic shutter speed computing circuit
43
44
45
46
47
39
Preamplifier
Signal processing circuit
A/D conversion circuit
Image compressing circuit
Memory drive circuit
Memory
42
Electronic shutter timing circuit
Imaging element drive circuit
41

Fig.4



67
66
48
35
68
36
65

Fig. 2



6
7
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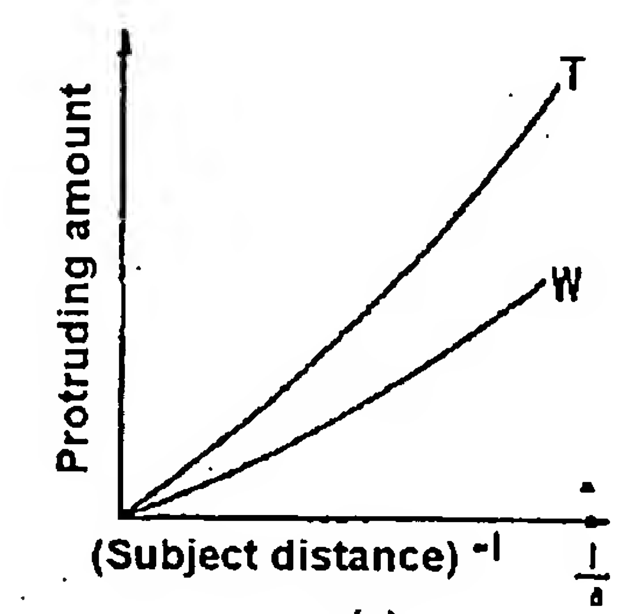
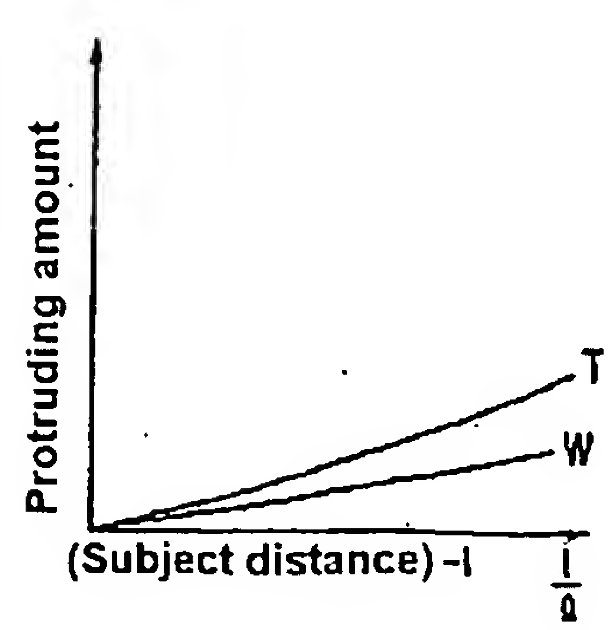
10
12
IRED
14
AF circuit
15
Protruding amount computing circuit
PSD
11
13
17
18
16
SPD
AE computing circuit
FM computing circuit
20
33
DX code reading circuit
19
Display circuit
30
28
Release input circuit
Zoom input circuit
29
21
22
Strobe emitting circuit
Light-emission control circuit
Control circuit
24
23
25
26
27
31
Lens encoder
Lens drive circuit
Shutter control circuit
Zoom drive circuit
Zoom encoder
Magnetic recording circuit
Film feeding circuit
32
1
3
2
4
5

Fig. 7



Protruding amount
T
W
(Subject distance) -1

(a)



Protruding amount
T
W
(Subject distance) -1

(b)

Fig.3

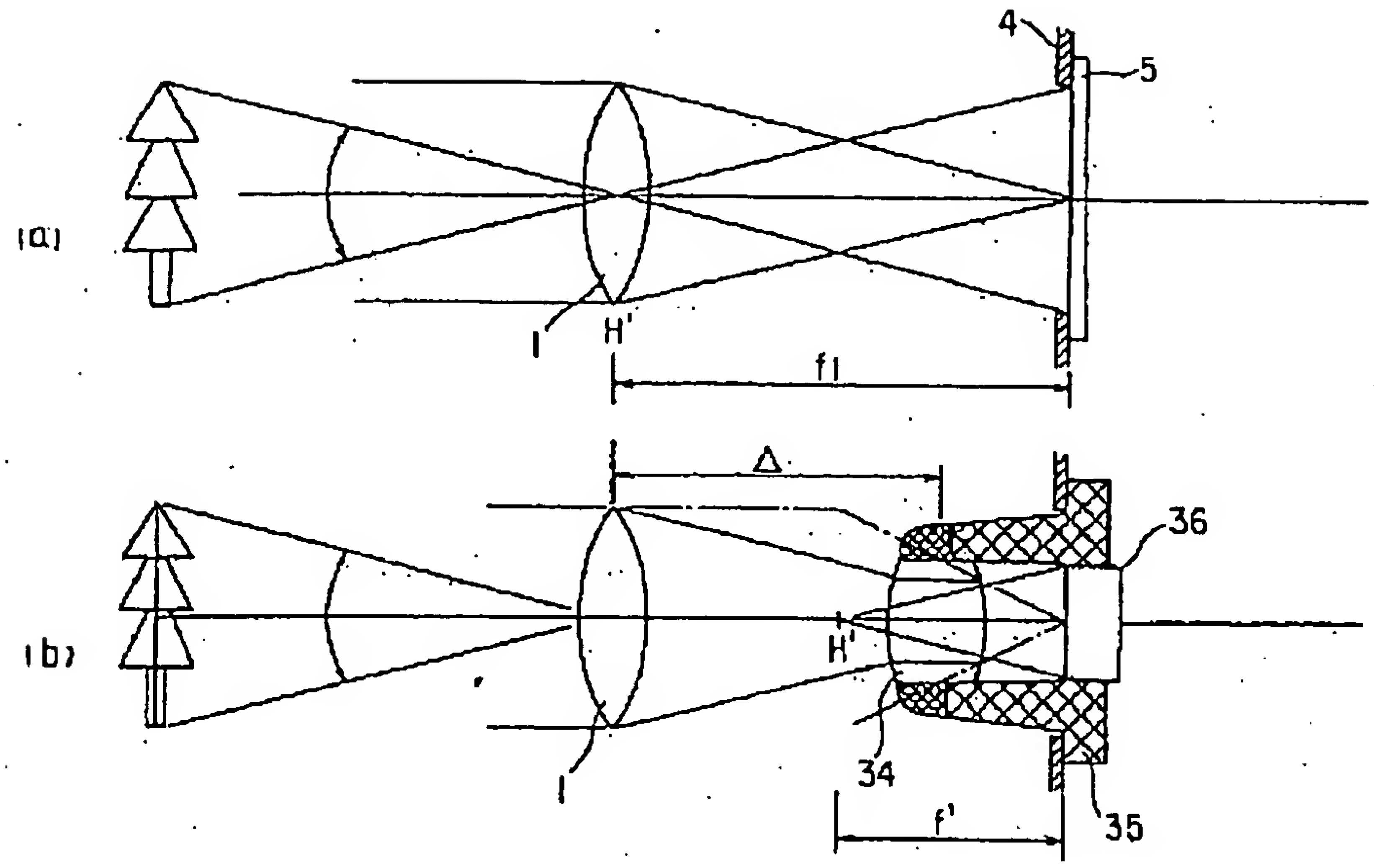
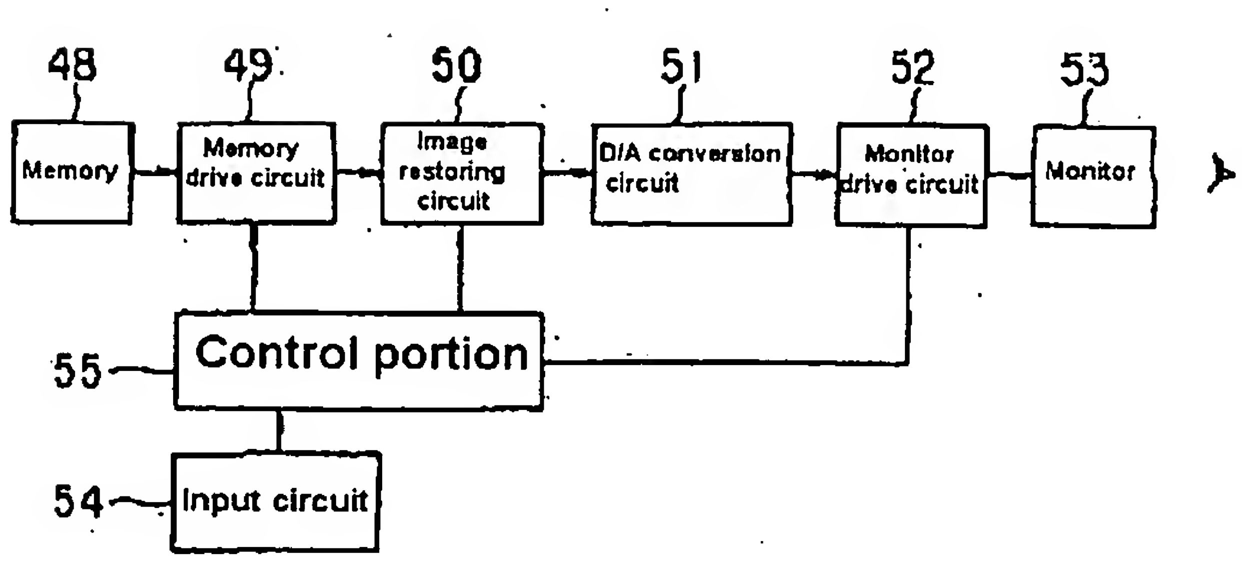


Fig.9

Fig. 8



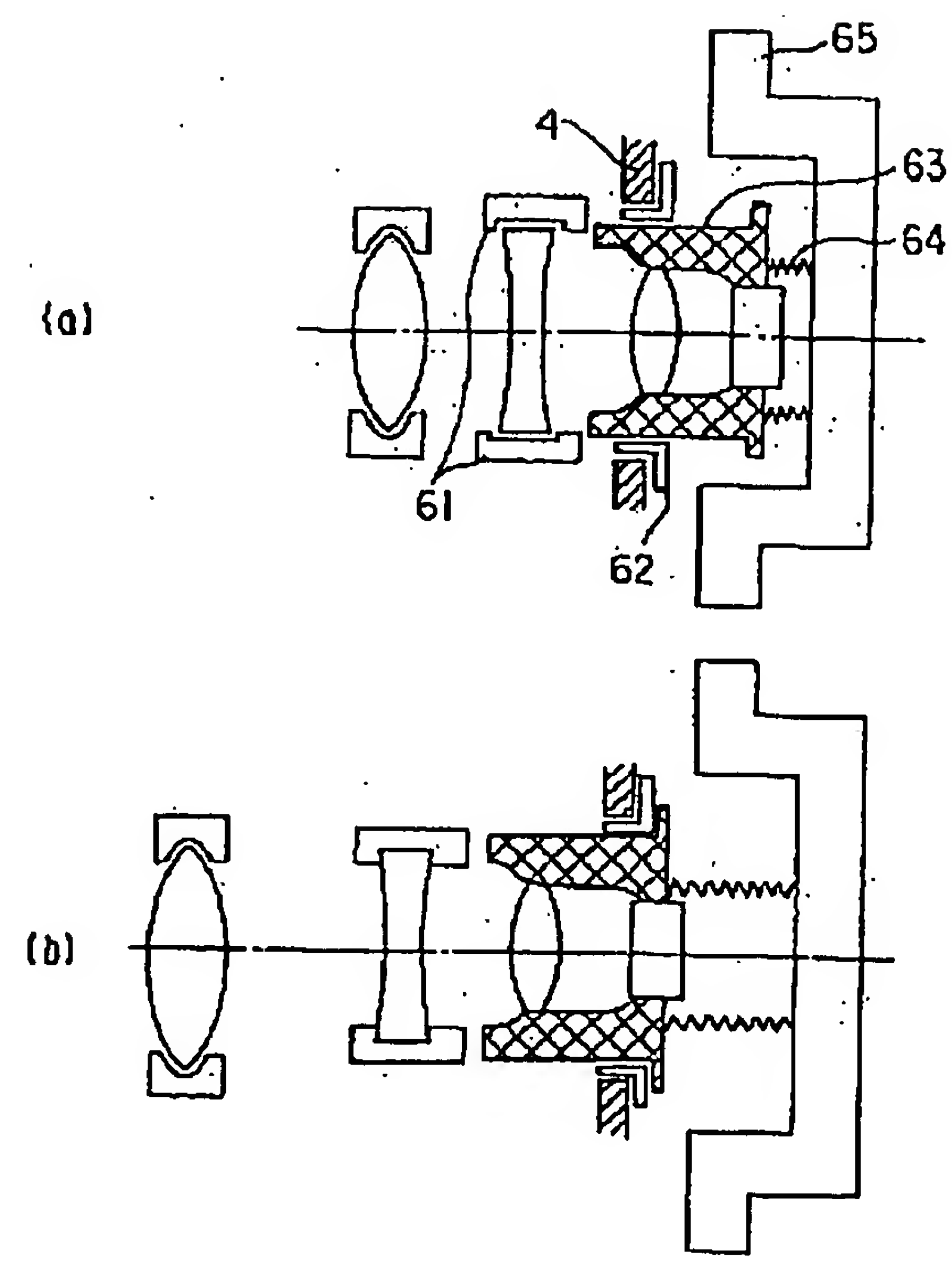
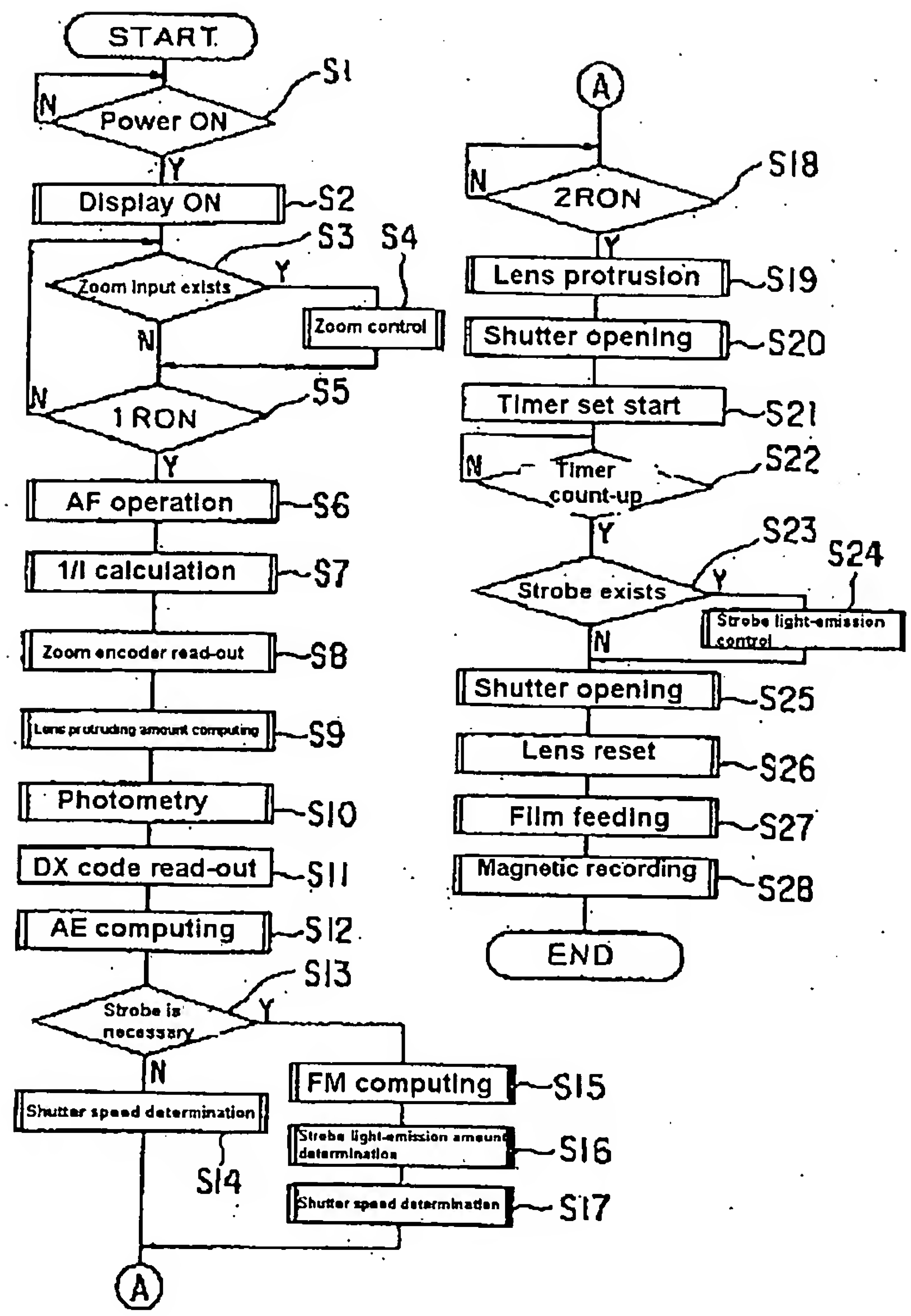
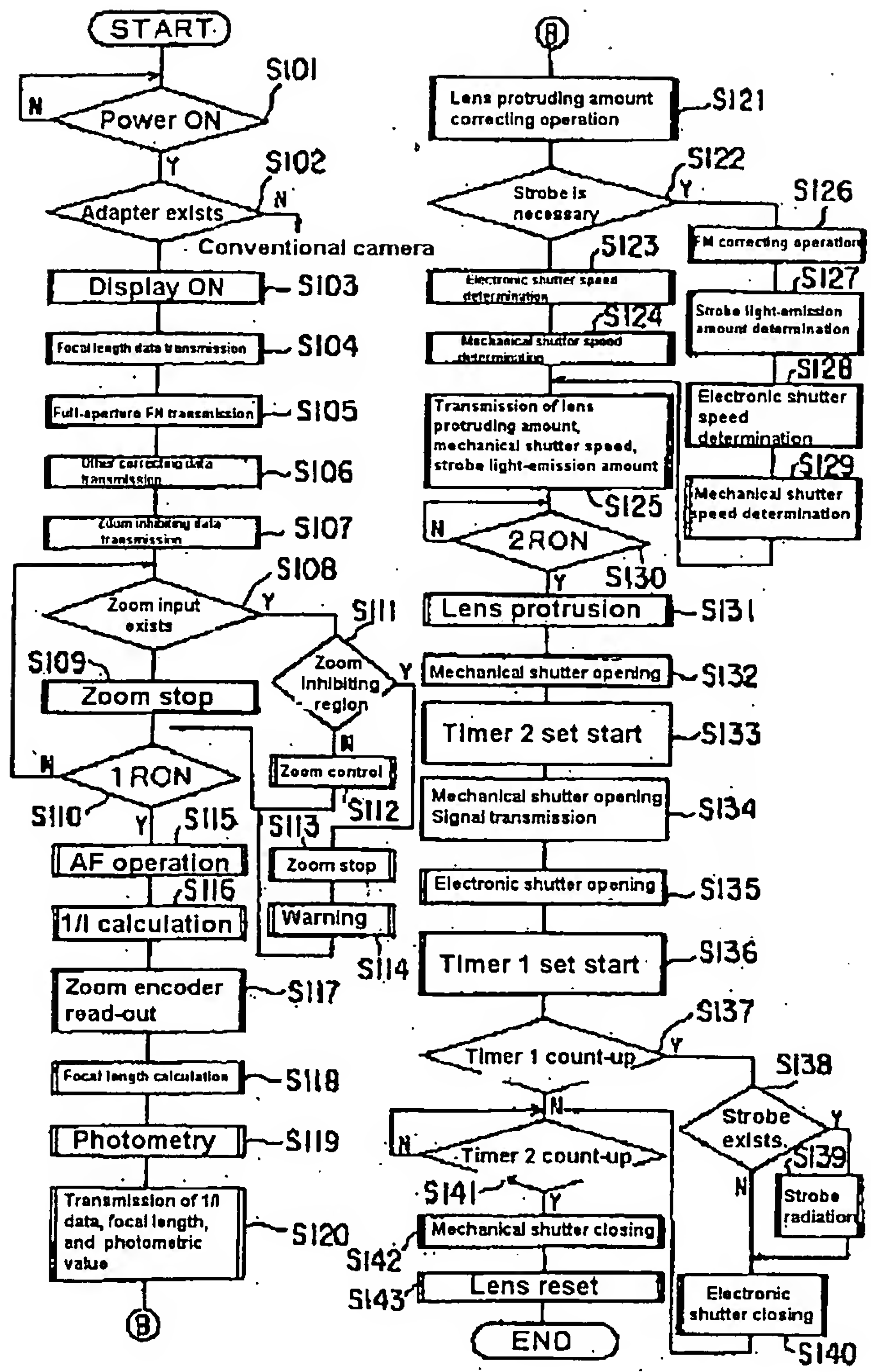


Fig. 5



START
S1
Power ON
N
Y
Display ON
S2
S3
S4
Zoom input exists
Y
Zoom control
N
N
1 RON
S5
Y
AF operation
S6
1/l calculation
S7
Zoom encoder read-out
S8
Lens protruding amount computing
S9
Photometry
S10
DX code read-out
S11
AE computing
S12
S13
Strobe is necessary
Y
N
Shutter speed determination
S14
FM computing
S15
Strobe light-emission amount determination
S16
Shutter speed determination
S17
A
A
2RON
S18
N
Y
Lens protrusion
S19
Shutter opening
S20
Timer set start
S21
Timer count-up
S22
N
Y
S23
S24
Strobe exists
Y
Strobe light-emission control
N
Shutter opening
S25
Lens reset
S26
Film feeding
S27
Magnetic recording
S28
END

Fig. 6


START
Power ON
S101
N
Y
Adapter exists
S102
N
Conventional camera
Display ON
S103
Focal length data transmission
S104
Full-aperture FN transmission
S105
Other correcting data transmission
S106
Zoom inhibiting data transmission
S107
Zoom input exists
S108
Y
S109
Zoom stop
Zoom inhibiting region
S111
Y
N
Zoom control
S112
1RON
S110
N
Y
S115
S113
AF operation
S116
Zoom stop
1/l calculation
Warning
S114
Zoom encoder read-out
S117
Focal length calculation
S118
Photometry
S119
Transmission of 1/l data, focal length, and photometric value
S120
B
B
Lens protruding amount correcting operation
S121
S122
Strobe is necessary
Y
S126
S123
FM correcting operation
Electronic shutter speed determination
S127
S124
Strobe light-emission amount determination
Mechanical shutter speed determination
S128
Transmission of lens protruding amount, mechanical shutter speed, strobe light-emission amount
Electronic shutter speed determination
S129
S125
Mechanical shutter speed determination
N
2RON
S130
Y
Lens protrusion
S131
Mechanical shutter opening
S132
Timer 2 set start
S133
Mechanical shutter opening Signal transmission
S134
Electronic shutter opening
S135
Timer 1 set start
S136
S137
Timer 1 count-up
Y
S138
N
Strobe exists
Y
N
Timer 2 count-up
S139
S141
Y
N
Strobe radiation
Mechanical shutter closing
S142
Lens reset
S143
Electronic shutter closing
END
S140